which have found favour. Mercury vapour saturated at a pressure of 5 mm. was excited to fluorescence by a cooled mercury vacuum arc, the light of the latter being filtered by a dilute solution of thiophene in alcohol, which completely cuts off wavelengths of 2460 or less. Under these conditions the fluorescence is excited exclusively by the core of the atomic resonance line. I have called such fluorescence the 'core effect'. The spectrogram shows the first three members of a series of bands originally found in absorption by R. W. Wood. These are at 2345, 2338, and 2334. Being of much shorter wave-length than any line from the thiophene-filtered source, the bands appear on a clear background free from false light. I do not know of any equally striking case of the violation of Stokes's law.

As regards interpretation, I limit myself at present to remarking that the experiment suggests a relation of Wood's bands to a 3P and not to the 1P state of the molecule. It would be easy to say a good deal more: but there has perhaps been a tendency to over-facile theorising on this subject, and further discussion is reserved.

RAYLEIGH.

Terling Place, Chelmsford,
Oct. 12.

Constitution of Thallium and Uranium.

THE preparation by Dr. v. Grosse of suitable volatile compounds of thallium and uranium has enabled me to obtain their mass-spectra. The lines of thallium were obtained by means of its triethyl compound. As was expected, it consists of two isotopes, 203, 205. The latter predominates to an amount in good agreement with the chemical atomic weight (204.39).

Results with uranium hexafluoride indicate that uranium is probably simple to at least 2 or 3 per cent. Its line 238 was photographed in satisfactory strength, followed by a series, 257 UF, 276 UF₂... etc. The last line visible in this series, 333, corresponding to UF₅, is the heaviest mass definitely recorded on a mass-spectrum. It has not yet been possible to determine the packing fraction of U 238.

F. W. ASTON.

Cavendish Laboratory,
Cambridge,
Oct. 8.

Raman Lines due to Co-ordination Bond.

FOLLOWING J. J. Thomson, Kossel, and others, it can be shown that a large number of observed facts about co-ordination compounds can be explained on the assumption that these groups are held by purely electrostatic forces to the central atom. Grimm has been able to calculate the heat of association per molecule of NH₃ surrounding the cation of a simple salt, from a knowledge of the heat of formation of the amines and the lattice energy of the simple salt. He has shown that for a monovalent cation with an octet shell the heat of association is 14 calories per gram molecule, 28 calories for a divalent ion, and so on. Also, the maximum co-ordination number of an atom can be shown to depend on the relative size of the latter to those of the co-ordination groups.

Other properties of such compounds, namely, the diamagnetism of certain complex radicles with a paramagnetic central atom, the change of valency of

the radicle when one of the co-ordinated group is replaced by another, for example, by the replacement of a NH₃ group by Cl, find an easy interpretation on the theory proposed by Sidgwick. According to this theory, the co-ordinated groups are bound to the central atom by homopolar bonds, in which both the electrons are supplied by the former. It has been pointed out by one of us¹ that from magnetic evidence alone it can be shown that even in the case of

FIG. 1.

co-ordination compounds of the iron group of elements there is not always a sharing of electrons as contemplated in Sidgwick's theory. According to our point of view, a true co-ordination bond occurs when the spin moment of one of the uncoupled electrons in the third shell of the central atom is neutralised by the spin moment of one of the two electrons supplied by the co-ordination group. This leads either to a complete neutralisation of the magnetic moment of the central atom or to a large reduction in its value.

From this point of view it is interesting to compare the magnetic moments of [Co(NH₃)₆]Cl₃ and [Co(NH₃)₆]Cl₂ with that of the simple salt CoCl₂. The first one is diamagnetic, and in it the NH₃ groups are replaceable by Cl with a lowering of the valency of the radicle, while the second compound has a magnetic moment almost the same as that of the simple salt, namely, 25 Weiss's magnetons, while that calculated according to Sidgwick's theory is 8.6.

Thus we see that the first one is a true co-ordination compound and the second is an associated compound. According to the view proposed here, since a co-ordination bond is a weak valency bond between the central atom and one of the co-ordinated group, the presence of such a bond ought to manifest itself in the Raman spectra. We have photographed the spectra of the radiation scattered by solutions of these two hexamine compounds, and have found definite evidence of the presence of modified lines in the case of the cobaltic compound, but not in the case of the other (Fig. 1). The mercury lines used by us were:

λ .	ν .	Intensity.
A 3650.2 A.	27,388 cm. ⁻¹	10
B 3654.8	27,354	6
C 3663.2	27,291	10

In some cases, by using a filter of Wood's glass (transmission 390-320 m μ), we have cut off all the other strong lines of mercury except those given above. With the cobaltic solution we obtained the following modified lines:

λ .	ν .	$\Delta\nu$.	Origin.	$\Delta\nu$.	Origin.
a 3715.8 A.	26,905 cm. ⁻¹	483	A - a	575	A - b
b 3728.5	26,813	478	c - b	562	C - c
c 3740.2	26,729				

It is supposed that the modified lines are due to the two strong mercury lines denoted by A and C, and the middle one represents two lines not resolved. That the absence of modified lines in the radiation scattered by the cobaltous compound is not due to the difference in the absorbing powers of the two